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System Design Teaching Model in Informatics Engineering Study Program

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Abstract. Design teaching which is part of the system development life cycle, both information systems and application systems is very important to be taught, learned and understood in the informatics engineering study program. System design teaching in private universities in Indonesia whose students are very diverse in terms of abilities and skills require teaching materials, lecture strategies, quality of lecturers and facilities that must also be able to adapt to the challenges and complexity in teaching. The study of system design teaching uses Hevner's information systems research framework which includes the steps of constructing artifacts in the form of constructs, models, methods, instances and evaluation of artifacts using case study in informatics engineering lecture. The use of the framework is intended to support business strategies and processes in study programs and to ensure the relevance of research. The result of research is a model and evaluation of the model. First, this research will produce a system design teaching model that can be used as a reference in the informatics engineering study program to produce graduates with good literacy, skills using the stages of system design, understanding user needs and system design capabilities. Second, evaluating the model that has been built by applying it to the case study on human computer interaction lecture and measuring the results of lectures to improve the quality of lecture material, teaching and students.

1. Introduction

The aim of higher education is to develop academics who are innovative, responsive, creative, skilled, competitive, and cooperative. Students majoring in informatics engineering are not only educated to have skills in mastering the use of information technology but also have reliable computer-aided system design skills. The high quality of students majoring in Informatics Engineering can be determined by the ability of these students to design systems that are fulfilling the requirements and useful for users. The student's ability factor will be supported by the student's skills as well as useful in complying and completing his studies [1]. The problem that then arises is how are the design skills to be taught in the classroom so that students will be able to enhance their abilities ? How can the study program and lecturers determine, identify, improve, teach and assess student design skills in accordance with the educational objectives of the Informatics Engineering department and university goals. Based on this, it is necessary to design a design teaching model to find out the teaching material and teaching methods for students.



2. Research Methodology

The methodology used in this research includes four stages : (1) Literature study related to the research, including the concept of system design, manage teaching intercourse, literacy, student skills in college and design science research. (2) Analysis of design teaching, student skills, and how they practice what has been taught. The analysis includes rigor and relevance of research based on design science to determine the construct of the system. (3) Designing a system by using the construct to design teaching model, a system design teaching model component and model based on the results of the analysis as a model development process (4) Evaluation of the design teaching model is carried out using case studies, conducted to test the design teaching model with a lecture in informatics engineering. The results of this study will contribute (1) scientific field that is to find the facts of system design teaching for students that can be carried out in the Informatics Engineering study program as a measure of quality and determination of the study program strategy and (2) practical contribution is to describe aspects that have to be considered by a researcher in developing the teaching system design model of Informatics Engineering study program and improving the quality of student teaching, the ability of students to establish system design, framework in application system design in research and the high quality of graduates in the field.

3. Teaching In Higher Education

Teaching and learning in universities and the use of technology are providing relevant material and activities that make students experience and make observations. Teaching and learning requires a syllabus that will make students have the ability to think creatively, ability to solve problems and make decisions [2] [3]. To be able to deliver teaching material and skills to students and come with good results, a lecturer must be a competent teacher who can helps students to learn. The role of lecturers in universities has several key roles in the education process, such as a lecturer of information, role models of students, facilitators, assessors, lecturers, resource builders for lecture materials [4] [5]. Literacy skills and information and communication technology as a form of new competence in education are important to be taught. The benefits of literacy, especially those related to information and communication technology are the access to literacy and information technology and computers. Skills are closely related to progress in human communication, using books or computers, and other sources of information, not only receiving information but also producing it, and literacy will eliminate digital divide [6] [7]. Teaching methods must be supported by a quality curriculum, accountable assessment, utilization of information and communication technology and clear literacy policies [8] [9]. Higher education in Indonesia refers to the Tri Dharma Perguruan Tinggi [10], where the activities of higher education are directed to teaching, community service and research. Especially regarding teaching and research, will be strongly supported by a good level of literacy [11].

4. Teaching System Design

System design teaching is to provide knowledge and understanding to students that designing is part of the system design life cycle, which starts from a system investigation to determine requirements through operation and maintenance [12][13]. Students will be taught that in designing, they must pay attention to the requirements of business processes, from organizations and users so that the design takes into account certain limitations. Students are taught to understand aspects of altruism, understand system requirements, use standards that is used for system design and have design skills (models and scenarios) [14]. Good design not only takes into account the requirements, but the designer also has a specific, measurable, workable, realistic and sufficient time [15]. In designing, students must have ideas and are supported by skills in implementing the idea. Students must have cognitive skills, problem solving skills, research skills, information technology skills, numerical skills, communication skills, group work skills, self-management skills and learning skills [16]. Teaching system design requires insight and knowledge supported by good literacy skills. Students have the ability in digital literacy, where the results of system design are created and presented in digital format [17]. Students can more easily communicate and express ideas and designs with digital literacy skills [18] [19]. The

next literacy needed in teaching system design is information literacy, to have conceptual competencies especially for research, human competence especially for understanding cultural differences and practical competencies such as the ability to learn which leads to lifelong learning [11] [20].

5. Design Science

Hevner [21] presents a conceptual framework for understanding, implementing, and evaluating information systems research by combining the behavioral-science and design-science paradigm. Environment to define problem space consist of are interesting phenomena. Information systems research includes people, business processes in organizations, and existing or planned technology. There are goals, tasks, problems and opportunities that define business needs as perceived by people in an organization. Business needs are assessed and evaluated in the context of organizational strategy, structure, culture and business processes, and are positioned relative to the available technology infrastructure. The purpose of design science research is to build or design artifacts to solve real, practical problems [22]. Research design science is aimed at building and evaluating artifacts designed to meet business needs. The resulting artifacts consist of (1) construct (vocabulary and symbols), (2) models (abstractions and representations), (3) methods (algorithms and practices), (4) instantiation (implementation and system prototypes), (5) better design theory and (5) methodology provides guidelines used in justifying or evaluating phases. Contributions from behavioral science and design science in information systems research are assessed because they are applied to business needs in an appropriate environment [23].

6. Analysis Of Teaching System Design

This section will conduct a strategic analysis of the Informatics Engineering study program, structure analysis of the teaching system design, analysis of the components of system design teaching and analysis of the teaching system design model.

6.1 Rigor Analysis

Rigor analysis is carried out to obtain knowledge that can be used in teaching system design, to determine the construct that will be used in the study. System design is a process which includes analysis of requirements derived from research on system users, determining system functions which are the requirements for system development followed by design stages which include user analysis and system modelling [24] [12]. The resulting construct is system design. System design teaching must be supported by a good level of literacy, both lecturers and students. Skills in information literacy mean that teaching will be equipped with a set of abilities from individuals to recognize the information needed and have the ability to search, evaluate, and effectively use the information needed [25]. The resulting construct is information literacy. Utilization of information literacy combined with digital literacy to support design skills. Teaching supported by digital literacy requires four competencies, which is technical competence in information technology, information competence, social competence to interact in the social sphere and epistemological competencies, competence in teaching to create new knowledge from previous competencies [18]. The constructs produced are digital literacy. Teaching or lecturing in higher education is a planned effort to realize the learning atmosphere and learning process so that students in universities can actively develop themselves to achieve their potential [10]. Education is not an activity that will has an immediate result, the teaching task is to carry out the teaching process as well as possible because the good, planned and measurable teaching process is also an educational product [26]. The constructs produced are teaching and college.

6.2 Relevance Analysis

Teaching in universities will make students as teaching subjects, who receive knowledge and conduct the learning process guided by lecturers. Students will be educated to have system abstraction skills, enhancing insights that are supported by information literacy and digital literacy capabilities and

directed towards system development in the form of system models. The constructs produced are the students. Teaching system design in the informatics engineering study program in its implementation using the teaching syllabus and taught by lecturers who are competent in their fields. The responsibility of the study program to develop a syllabus that supports the educational objectives of the study program, can be accounted for scientifically, in line with the education strata and has lecturers who match their qualifications. The study program provides facilities and infrastructure that can support the teaching of system design, so that teaching activities can be carried out properly. The results of teaching process will produce students achieve the required potential in the syllabus, produce skilled students and make qualified graduates. The resulting construct is a study program.

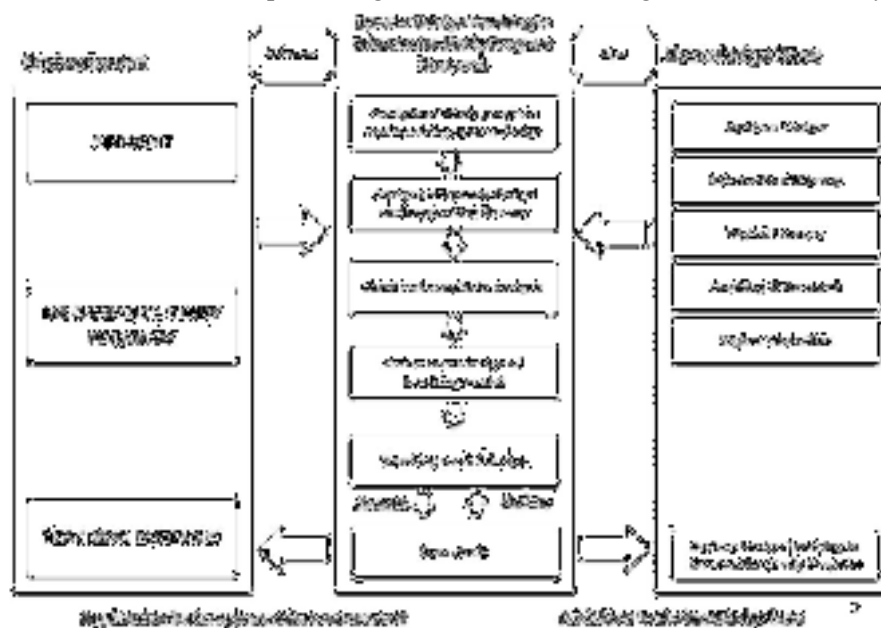


Figure 1. Research Framework (Adaptation from Information System Research Framework)

Teaching in current universities in accordance with the syllabus that has been prepared, in practice requires certain appropriate teaching methods. Lecturers have perceptions, knowledge, judgments and ideas in teaching system design that are supported by real experiences to be taught to students. This teaching requires teaching methods that will facilitate, involve, communicate and make judgments. Lecturers will act as facilitators in the transfer of knowledge, students will receive and be actively involved in teaching as the subject of teaching, communication that is established between lecturers and students in the transfer of knowledge and objective assessments related to student achievement. Teaching system design requires the support of facilities, tools, information technology and computers as support for lecture materials and tools for designing practice. The resulting construct is a teaching method.

6.3 Construct Determination

Based on the analysis that has been done above, the construct used in the teaching of system design has conformity with the relevance analysis that has been done before, where the teaching of system design is as follows :

- 'What' is system design, system design course material taught in class by lecturers.
- 'When' is lectures, lectures in the informatics engineering study program curriculum.
- 'Where' is program study of informatics engineering, where education and learning about system design are implemented.
- 'Who' is students, who take classes, understand and practice system design to achieve the skills needed in system development.

- ‘Why’ is student skills, skills taught, exemplified and practiced in several subjects with different goals, difficulty levels and assessments.

‘How’ is teaching methods, the right way to teach skills in system design and refer to the syllabus, curriculum and conditions of students in the classroom.

7. Teaching System Design

The approach taken in teaching system design in the informatics engineering study program refers to design which is part of the system development life cycle. Teaching carried out not only paid attention to aspects of knowledge, teaching and student skills but also formed an educational process that was good, structured, easily evaluated and produced experience and awareness for students. Experience in designing that starts from the idea, getting to know the user, utilizing tools and literacy sources up to the development of a design model in group work. Awareness of the user's system needs, cultural differences, the need for good insight and the importance of continuous learning.

7.1 Components In Teaching System Design

The system design teaching component is not only limited to teaching between lecturers and students in class, but also involves other components that are important in teaching. System design teaching includes the following components: (1) syllabus that is teaching references for lecturers, the process of using syllabus in teaching can produce revisions and adjustments to scientific and technological progress, (2) lecturers as education implementers, facilitators and sources of knowledge in designing the system that carries out the teaching process, (3) the lecturer carries out the teaching method in the lecture process, (4) the results of the teaching process come from previous research and can be used for further research, either by lecturers or by students, (5) design teaching materials supported by the process of utilizing digital literacy and information literacy and (6) students as subjects of education who carry out the learning process.

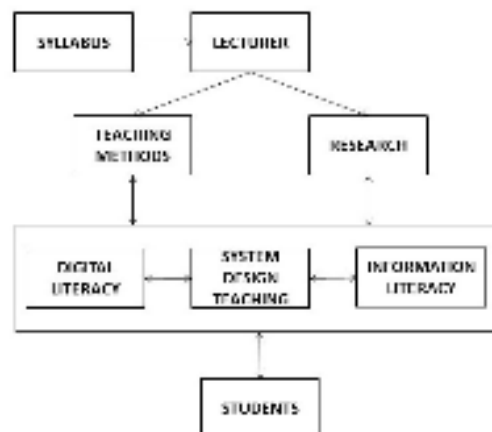


Figure 2. Components in System Design Teaching

7.2 Teaching Models Of System Design

The system design teaching model has 3 external components, (1) digital literacy as input in the form of utilization digital technology and output in the form of system design products, (2) information literacy as input as a conceptual basis for system design and output of system design results that can be further researched. and (3) students as subjects of teaching who do system design and get output in the form of scientific improvement and system design skills. System requirements and the results of research on users for system design are basic concepts in teaching system design. Students are educated to know and understand the stages of system development up to the system design stage. At the identification stage the requirements and management of user research results, teaching also takes into account three things, that is ideas, skills and altruism. Students are given teaching materials and

literacy to develop ideas, either from the development of an existing system design or original ideas directed by the lecturer. Students have and develop skills in designing systems, making models and prototypes and utilizing tools that will facilitate design. Students are taught to try to understand the needs of system users, think through the user's point of view and desires and improve the ability to prioritize users.

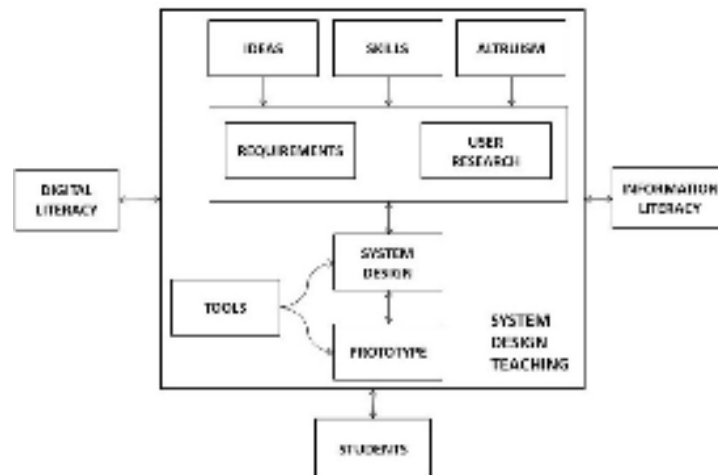


Figure 3. System Design Teaching Model

8. Method & Instantiation

The method which is a design science artifact, defines the way and use of the model that has been made. The method will utilize components in the teaching model design system in informatics engineering lecture material and utilizing information systems in the engineering faculty to manage lecture data and assessment result. Instantiation is the implementation of constructs, models and methods into a system of teaching, skills training and assessment of lectures in lectures that teach system design. Instantiation begins with the development of ideas from students and ends with a presentation of a system prototype or system design.

9. Evaluation

The evaluation method used is observational in a case study, was carried out in a lecture on human computer interaction in the even semester of 2017/2018. Evaluation was carried out in 14 lecture meetings in 3 classes with 98 students. Components in the teaching system design model are applied and evaluated by assessments that focus on designing the user interface in the application system prototype. The result of assessment teaching system design has a 40% of total score of the lecture. The product of system design is a design idea represented by the system user interface including application system scenarios, application system prototypes, task presentations and report generation. Evaluation of the model's implementation includes the originality of the design idea, the skills that are owned and used, the application of altruism in ideas, literacy in the use of references, implementation of system design, use of tools and prototyping. The results of the assessment are : 62.21% of students get a graduation score with an assessment varying between very good, good and sufficient and 37.77% of students do not get graduation scores with less and very less assessment. Analysis of the assessment of students who did not pass is shown because of (1) lack of management skills, especially self and group management, (2) low literacy skills, (3) modeling skills and (4) system analysis and abstraction capabilities. Based on the determination of constructs, analysis, modeling, method, instantiation and evaluation of teaching system design, the results are as follows :

- Syllabus : The syllabus prepared in the lecture with the subject of system design is based on standards recognized nationally and internationally. The syllabus compiled refers to the Indonesian Qualification Framework, the Association for Computing Machinery (ACM) and the Association for Information Systems (AIS). The syllabus for system design is distributed

in several courses, with lecture material that is gradual and in several parts will be repeated and interconnected.

- **Teaching Strategy** : The system design teaching strategy is made by teaching methods with a gradual level of difficulty with repetition for subjects that are important for students to understand.
- **Skills** : The skills needed and taught to students must be repeated and not just in one lecture, but from several lectures that teach the design of an integrated and well coordinated system.
- **Standardization** : Standardization in the ability of students, especially in self-management, group work and literacy. The problem of teaching in private universities in Indonesia is the very diverse level of student ability which makes it difficult to deliver subjects.
- **Research** : The process of teaching system design in lectures can be developed into research conducted by students with the guidance of lecturers. Original ideas from students are maintained and developed in research even when the lecture has been completed, for example with research objectives for graduation.

Human Computer Interaction Lecture

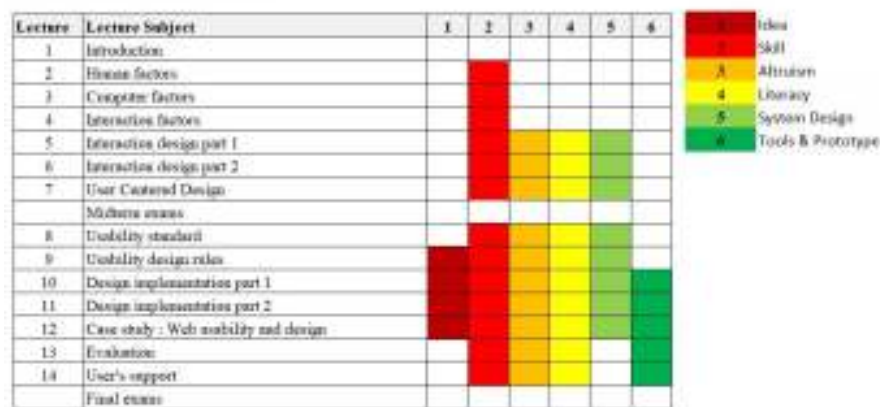


Figure 4. Case study for evaluating the teaching system design model

10. Conclusion

The conclusion obtained is that research using information system framework contributes to the knowledge base, that is designing a system design teaching model in informatics engineering study programs as well as reviewing teaching strategies with digital literacy support and information literacy for system design and design support skills needs system, as well as contributing to the environment, providing input for lecturers on system design, teaching strategies, and evaluation of model. Evaluation of the model that has been built is done using case studies and observations in lectures. The results of evaluations that have been carried out showed that, the model can be used to provide input and improvements to the syllabus, teaching strategies, skills needed, standardization used and research needs. The model that has been built is not enough to only be used and evaluated but must also be communicated with other lecturers and subjects in the study program environment.

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